



## **Modelling the Growth of a Canadian Military Occupation**

MORS Personnel and National Security Workshop

January 2010

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Department of National Defence



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## Background

- New occupation in Canadian Forces being created
- Managers plan to grow the occupation by 400%, and require guidance to manage the transition
- For a variety of possible scenarios, modelling can help to:
  - determine time to grow to end goal
  - determine intake required to sustain population at a certain point
  - identify problems that are likely to arise



# **Part 1: Methodology**



## Model Overview

- Batch File
  - Allows user to run many scenarios without human intervention
  - Stores all VBA code
- Scenario File
  - Acts as user interface
  - Input and output data can be entered/viewed
  - One file per scenario



## Model Overview

- Model
  - Excel-based stochastic simulation engine
  - Entity-based
    - Each individual is represented in the model
    - Attributes: Rank, YOS, TIR
  - Model simulates
    - Attrition
    - Promotion
    - Intake

for a period of up to 30 years



# **Walk-Through: Scenario File**

Microsoft Excel - MORS Sample.xls																
File Edit View Insert Format Tools Data Window Help																
Type a question for help																
10 B % .00 .00																
A37																
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Scenario Name:	MORS Sample														
2	# Iterations:	20														
4	Start Year:	2010	# Years:	20												
6	PML															
7	Rank	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
8	Pte	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	Cpl	51	51	51	51								51	51	51	51
10	MCpl	17	17	17	17								34	34	34	34
11	Sgt	11	11	11	11								14	14	14	14
12	WO	7	7	7	7								15	15	15	15
13	MWO	3	3	3	3								6	6	6	6
14	CWO	1	1	1	1								1	1	1	1
16	Intake Plan 1	VOT														
17	Rank	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
18	Pte															
19	Cpl	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4
20	MCpl															
21	Sgt															
22	WO															
23	MWO															
24	CWO															
26	Intake Plan 2	DE														
27	Rank	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
28	Pte				10	5	10	8	1	0	0	1	8	1	10	10
29	Cpl															
30	MCpl															
31	Sgt															
32	WO															
33	MWO															
34	CWO															
35																

General Parameters

- Scenario Name
- # Iterations
- Start Year
- # Simulation Years

Preferred Manning Level (PML)

- Number of positions at each rank
- Specified for each simulation year



Microsoft Excel - MORS Sample.xls

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Type a question for help

B19 =MIN(5,MAX(0,[Model\_30yr.xls]Year 1!\$AM\$6))

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	<b>Scenario Name:</b> MORS Sample																
2	<b># Iterations:</b> 20																
4	<b>Start Year:</b> 2010 <b># Years:</b> 20																
6	<b>PML</b>																
7	<b>Rank</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>	<b>2023</b>	<b>2024</b>	<b>2025</b>
8	<b>Pte</b>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	<b>Cpl</b>	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51
10	<b>MCpl</b>	17	17	17	17	17	34	34	34	34	34	34	34	34	34	34	34
11	<b>Sgt</b>	11	11	11	11	11	14	14	14	14	14	14	14	14	14	14	14
12	<b>WO</b>	7	7	7	7	7	15	15	15	15	15	15	15	15	15	15	15
13	<b>MWO</b>	3	3	3	3	3	6	6	6	6	6	6	6	6	6	6	6
14	<b>CWO</b>	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
16	<b>Intake Plan 1</b>		<b>VOT</b>														
17	<b>Rank</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>	<b>2023</b>	<b>2024</b>	<b>2025</b>
18	<b>Pte</b>																
19	<b>Cpl</b>	5	5	4	4	4											
20	<b>MCpl</b>																
21	<b>Sgt</b>																
22	<b>WO</b>																
23	<b>MWO</b>																
24	<b>CWO</b>																
26	<b>Intake Plan 2</b>		<b>DE</b>														
27	<b>Rank</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>	<b>2023</b>	<b>2024</b>	<b>2025</b>
28	<b>Pte</b>				10	5											
29	<b>Cpl</b>																
30	<b>MCpl</b>																
31	<b>Sgt</b>																
32	<b>WO</b>																
33	<b>MWO</b>																
34	<b>CWO</b>																
35																	

Parameters Background Data Average Results Average Intake Temp 1 Temp 2

Ready NUM

### Intake Plans

- Two plans can be specified; each can vary by rank and simulation year
- User can link intake to simulation results to limit intake so that Trained Effective Strength (TES) does not exceed PML
- In this case:
  - Voluntary Occupational Transfer (Cpl)
  - Direct Entry (Pte)

Microsoft Excel - MORS Sample.xls										
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A47										
	A	B	C	D	E	F	G	H	I	J
1	Year #	1	2	3	4	5	6	7	8	9
2	Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
3	Data Column	2	3	4	5	6	7	8	9	10
4										
5	Attrition by YOS									
6	Year \ YOS	0	1	2	3	4	5	6	7	8
7	2010	13%	2%	1%	6%	3%	3%	4%	2%	2%
8	2011	13%	2%	1%	6%	3%	3%	4%	2%	2%
9	2012	13%	2%					4%	2%	2%
10	2013	13%	2%					4%	2%	2%
11	2014	13%	2%					4%	2%	2%
12	2015	13%	2%					4%	2%	2%
13	2016	13%	2%					4%	2%	2%
14	2017	13%	2%	1%	6%	3%	3%	4%	2%	2%
15	2018	13%	2%	1%	6%	3%	3%	4%	2%	2%
16	2019	13%	2%	1%	6%	3%	3%	4%	2%	2%
17	2020	13%	2%	1%	6%	3%	3%	4%	2%	2%
18	2021	13%	2%	1%	6%	3%	3%	4%	2%	2%
19	2022	13%	2%	1%	6%	3%	3%	4%	2%	2%
20	2023	13%	2%	1%	6%	3%	3%	4%	2%	2%
21	2024	13%	2%	1%	6%	3%	3%	4%	2%	2%
22	2025	13%	2%	1%	6%	3%	3%	4%	2%	2%
23	2026	13%	2%	1%	6%	3%	3%	4%	2%	2%
24	2027	13%	2%	1%	6%	3%	3%	4%	2%	2%
25	2028	13%	2%	1%	6%	3%	3%	4%	2%	2%
26	2029	13%	2%	1%	6%	3%	3%	4%	2%	2%
27	2030	13%	2%	1%	6%	3%	3%	4%	2%	2%
28	2031	13%	2%	1%	6%	3%	3%	4%	2%	2%
29	2032	13%	2%	1%	6%	3%	3%	4%	2%	2%

Attrition Rates  
-Specified by Years of Service (YOS) and simulation year

Parameters Background Data Average Results Average Intake Temp 1 Temp 2

Microsoft Excel - MORS Sample.xls												
File Edit View Insert Format Tools Data Window Help												
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A55												
	A	B	C	D	E	F	G	H	I	J		
1	Year #	1	2	3	4	5	6	7	8	9		
2	Year	2010	2011	2012	2013	2014	2015	2016	2017	2018		
3	Data Column								9	10		
4		<div>Time In Rank (TIR) Required for Promotion</div> <div>-User can set the minimum amount of time that must be spent in a rank before an individual is eligible for promotion</div> <div>-Represents what SMEs believe will be desirable/typical; not necessarily policy-driven</div>										
5	Attrition by YOS											
6	Year \ YOS										7	8
7	2010										2%	2%
8	2011										2%	2%
9	2012										2%	2%
10	2013										2%	2%
11	2014	2%	2%									
12	2015	2%	2%									
36	2039	13%	2%	1%	6%	3%	3%	4%	2%	2%		
37												
38	TIR Req'd for Promotion Out		Desirable YOS Range for Promotion Out									
39	Out of Rank	TIR		Out of Rank	Min	Max						
40	Pte	3		Pte	0	45						
41	Cpl	2		Cpl	0	45						
42	MCpl	3		MCpl	0							
43	Sgt	4		Sgt	0							
44	WO	4		WO	0							
45	MWO	4		MWO	0							
46	CWO	99		CWO	99							
47												
48	Effective TIR Adjustment											
49	Intake Plan	Pte	Cpl	MCpl	Sgt							
50	VOT		-1									
51	DE											
52												

ParametersBackground DataAverage ResultsAverage IntakeTemp 1Temp 2

ReadyNUM

**Desirable YOS Range for Promotion**

-User can set min/max YOS that an individual must have to be eligible for promotion; e.g. if someone hasn't been promoted by X YOS, he/she likely never will be

Microsoft Excel - MORS Sample.xls										
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A55										
	A	B	C	D	E	F	G	H	I	J
1	Year #	1	2	3	4	5	6	7	8	9
2	Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
3	Data Column	2	3	4	5	6	7	8	9	10
4										
5	Attrition by YOS									
6	Year \ YOS	0	1	2	3	4	5	6	7	8
7	2010	13%	2%	1%	6%	3%	3%	4%	2%	2%
8	2011	13%	2%	1%	6%	3%	3%	4%	2%	2%
9	2012	13%	2%	1%	6%	3%	3%	4%	2%	2%
10	2013	13%	2%	1%	6%	3%	3%	4%	2%	2%
11	2014							4%	2%	2%
12	2015							4%	2%	2%
36	2039							4%	2%	2%
37										
38	TIR Req'd for F									
39	Out of Rank									
40	Pte									
41	Cpl									
42	MCpl									
43	Sgt									
44	WO									
45	MWO									
46	CWO									
47										
48	Effective TIR Adjustment									
49	Intake Plan	Pte	Cpl	MCpl	Sgt	WO	MWO	CWO		
50	VOT		-1							
51	DE									
52										

Effective TIR Adjustment

- Entrants from different intake plans may have different amounts of time they must spend at each rank; the user can apply adjustments here
- In this case, VOT entrants spend one more year at Cpl rank than do DE entrants

Microsoft Excel - MORS Sample.xls												
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A167												
A B C D E F G H I J K L												
55												
56	Intake Plan 1 (VOT) YOS and TIR Distributions											
57	Rank \ YOS	X	0	1	2	3	4	5	6	7	8	9
58	Pte	0.00	1.00									
59	Cpl	0.00	3%	6%	10%	18%	33%	48%	60%	68%	72%	75%
60	MCpl	0.00	1.00									
61	Sgt	0.00	1.00									
62	WO	0.00	1.00									
63	MWO	0.00	1.00									
64	CWO	0.00	1.00									
65	Rank \ TIR	X	0	1	2	3	4	5	6	7	8	9
66	Pte	0.00	1.00									
67	Cpl	0.00	1.00									
68	MCpl	0.00	1.00									
69	Sgt	0.00	1.00									
70	WO	0.00	1.00									
71	MWO	0.00	1.00									
72	CWO	0.00	1.00									
73												
74	Intake Plan 2 (DE) YOS and TIR Distributions											
75	Rank \ YOS	X	0	1	2	3	4	5	6	7	8	9
76	Pte	0.00	0.00	1.00								
77	Cpl	0.00	1.00									
78	MCpl	0.00	1.00									
79	Sgt	0.00	1.00									
80	WO	0.00	1.00									
81	MWO	0.00	1.00									
82	CWO	0.00	1.00									
83	Rank \ TIR	X	0	1	2	3	4	5	6	7	8	9
84	Pte	0.00	1.00									
85	Cpl	0.00	1.00									
86	MCpl	0.00	1.00									
87	Sgt	0.00	1.00									
88	WO	0.00	1.00									
89	MWO	0.00	1.00									
90	CWO	0.00	1.00									

YOS and TIR Distributions (for each Intake Plan)  
 -Specifies the YOS and TIR that personnel have upon entering the occupation  
 -Values represent cumulative percentages

Microsoft Excel - MORS Sample.xls										
File Edit View Insert Format Tools Data Window Help										
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A73										
	A	B	C	D	E	F	G	H	I	J
92	<b>Starting Population</b>									
93	<b>Rank</b>	<b>YOS</b>	<b>TIR</b>							
94	Cpl	3	0							
95	Cpl	7	2							
96	Cpl	5	3							
97	Cpl	2	2							
98	Cpl	5	3							
99	MCpl	7	0							
100	Cpl	14	10							
101	Cpl	9	5							
102	Cpl	8	5							
103	Cpl	8	4							
104	Cpl	12	8							
105	Cpl	6	3							
106	Cpl	7	3							
107	Cpl	20	16							
108	Cpl	6	2							
109	MCpl	10	0							
110	Cpl	5	1							
111	Cpl	12	8							
112	Cpl	7	3							
113	Cpl	3	1							
114	Cpl	5	2							
115	Cpl	8	5							
116	Cpl	4	2							
117	Cpl	4	3							
118	Cpl	6	3							
119	Cpl	8	4							
120	Cpl	7	1							
121	Cpl	9	5							
122	Cpl	4	1							

Starting Population

-Rank, YOS, and TIR must be specified for each person in the initial population

Parameters Background Data Average Results Average Intake Temp 1 Temp 2

Ready

NUM



Microsoft Excel - MORS Sample.xls												
File Edit View Insert Format Tools Data Window Help												
Type a question for help												
A81												
	A	B	C	D	E	F	G	H	I	J	K	L
1	Average Forecast TES Population											
2	Rank	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
3	Pte/Cpl	30.5	32.7	33.4	45.8	51.0	48.0	50.4	51.0	51.0	51.0	51.0
4	MCpl	17.0	17.0								32.6	29.5
5	Sgt	11.0	11.0								14.0	14.0
6	WO	5.7	5.8								9.7	14.1
7	MWO	1.9	1.8								5.7	6.0
8	CWO	0.0	0.0								1.0	1.0
9	Total	66.1	68.3								114.0	115.6
10												
11	Average % PML											
12	Rank	2010	2011								2019	2020
13	Pte/Cpl	60%	64%								100%	100%
14	MCpl	100%	100%								96%	87%
15	Sgt	100%	100%								100%	100%
16	WO	81%	83%								65%	94%
17	MWO	63%	58%								95%	100%
18	CWO	0%	0%								100%	100%
19	Total	73%	76%								94%	96%
20												
21	Average TES Rank to Rank Ratio											
22	Rank	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
23	Pte/Cpl : MCpl	1.79	1.92	1.96	2.66	3.00	1.56	1.67	1.66	1.61	1.57	1.74
24	MCpl : Sgt	1.55	1.55	1.55	1.55						3	2.11
25	Sgt : WO	1.95	1.97	1.57	1.57						0	1.00
26	WO : MWO	3.15	3.15	4.20	3.09						2	2.35
27	MWO : CWO	0.00	0.00	1.45	2.30						0	6.00
28												
29	Average TES Attrition Volume											
30	Rank	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020

## Results

-For each simulation year and rank, results are averaged over all iterations

-Results include:

-Average Forecast TES Population

-Average %PML Filled (i.e. TES/PML)

-Average TES Rank-to-Rank Ratio

-Average TES Attrition Volume

-Average Number of Promotions

-Average TIR at Promotion

-Average Intake

-Temp 1 and Temp 2 tabs are used along with macros to calculate the results averaged over all iterations



# **Walk-Through: Model File**



Microsoft Excel - Model_30yr.xls														
File Edit View Insert Format Tools Data Window Help														
Type a question for help														
A39														
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	<b>Start Year:</b>		2010	<b># Years:</b>		20								
2														
3	<b>PML</b>													
4	<b>Rank</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>
5	Pte	0	0	0	0	0	0	0	0	0	0	0	0	0
6	Cpl	51	51	51	51	51	51	51	51	51	51	51	51	51
7	MCpl	17	17	17	17	17	34	34	34	34	34	34	34	34
8	Sgt	11	11	11	11	11	14	14	14	14	14	14	14	14
9	WO	7	7	7	7	7	15	15	15	15	15	15	15	15
10	MWO	3	3	3	3	3	6	6	6	6	6	6	6	6
11	CWO	1	1	1	1	1	1	1	1	1	1	1	1	1
12														
13	<b>Intake Plan 1</b>		VOT											
14	<b>Rank</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>
15	Pte													
16	Cpl	5	5	4	4	4	4	4	4	4	4	4	4	4
17	MCpl													
18	Sgt													
19	WO													
20	MWO													
21	CWO													
22														
23	<b>Intake Plan 2</b>		DE											
24	<b>Rank</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>
25	Pte													
26	Cpl													
27	MCpl													
28	Sgt													
29	WO													
30	MWO													
31	CWO													

Input and Background Data  
-Copied from Scenario file using macros

Input Background Data Intake Processing Results Year 1 Year 2 Year 3 Year 4 Year 5 Year 6 Year 7 Year 8 Year 9 Year 10

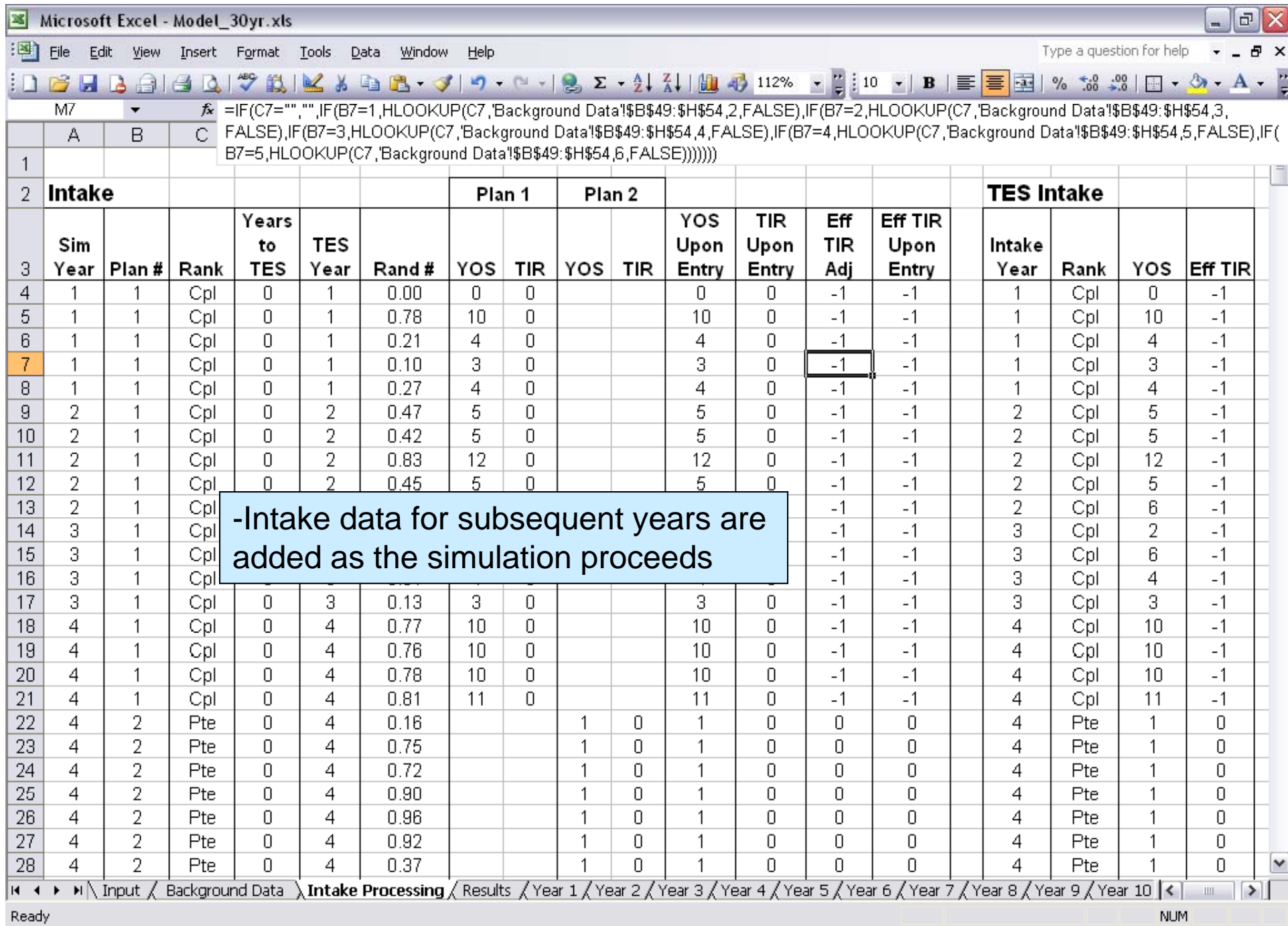
Microsoft Excel - Model_30yr.xls																				
File Edit View Insert Format Tools Data Window Help																				
Type a question for help																				
A61 fx																				
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	
1																				
2	Intake						Plan 1		Plan 2							TES Intake				
3	Sim Year	Plan #	Rank	Years to TES	TES Year	Rand #	YOS	TIR	YOS	TIR	YOS Upon Entry	TIR Upon Entry	Eff TIR Adj	Eff TIR Upon Entry		Intake Year	Rank	YOS	Eff TIR	
4	1	1	Cpl	0	1	0.00	0	0			0	0	-1	-1		1	Cpl	0	-1	
5	1	1	Cpl	0	1	0.78	10	0			10	0	-1	-1		1	Cpl	10	-1	
6	1	1	Cpl	0	1	0.21	4	0			4	0	-1	-1		1	Cpl	4	-1	
7	1	1	Cpl	0	1	0.10	3	0			3	0	-1	-1		1	Cpl	3	-1	
8	1	1	Cpl	0	1	0.27	4	0			4	0	-1	-1						
9																				
10	<div>-Using macros, intake data from Input tab are entered into first three columns</div> <div>-Random number used to determine YOS and TIR of entrants based on distribution specified in Background Data</div> <div>-Effective TIR Adjustment is applied where necessary, as specified in Background Data</div> <div>-Intake is summarized here; the data are later pasted into the Year tabs</div>																			
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Input Background Data Intake Processing Results Year 1 Year 2 Year 3 Year 4 Year 5 Year 6 Year 7 Year 8 Year 9 Year 10																				
Ready NUM																				

-Using macros, intake data from Input tab are entered into first three columns

-Random number used to determine YOS and TIR of entrants based on distribution specified in Background Data

-Effective TIR Adjustment is applied where necessary, as specified in Background Data

-Intake is summarized here; the data are later pasted into the Year tabs



Microsoft Excel - Model_30yr.xls										
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Type a question for help										
A86 fx										
	A	B	C	D	E	F	G	H	AN	AO
1	2010	Data Column	2							
2										
3	Starting Population		63							
4	Rank	YOS	Effective TIR	P(Attrition)	Random #	Attrition?	Eligible for Promotion?	Suitable?		
5	Cpl	3	0	6%	0.62	0	0	0		
6	Cpl	7	2	2%	0.70	0	0	0		
7	Cpl	5	3	3%	0.61	0	1	1		
8	Cpl	2	2	1%	0.93	0				
9			3	3%	0.07	0				
10			0	2%	0.16	0				
11			10	1%	0.74	0				
12			5	2%	0.07	0				
13			5							
14			4							
15			8							
16	Cpl	6	3				1	1		
17	Cpl	7	3				1	1		
18	Cpl	20	16				0	0		
19	Cpl	6	2				0	0		
20	MCpl	10	0				0	0		
21	Cpl	5	1				0	0		
22	Cpl	12	8				1	1		
23	Cpl	7	3				1	1		
24	Cpl	3	1	6%	0.59	0	0	0		
25	Cpl	5	2	3%	0.52	0	0	0		
26	Cpl	8	5	2%	0.04	0	1	1		
27	Cpl	4	2	3%	0.18	0	0	0		

-Macros are used to paste the starting population

-Based on the attrition rates specified in Background Data, attrition is evaluated using a random number

-Eligibility/Suitability for promotion are evaluated based on the individual's TIR and YOS

Microsoft Excel - Model\_30yr.xls

File Edit View Insert Format Tools Data Window Help

Type a question for help

W6 =MAX(MIN(T6,V6+W7),0)

	P	Q	R	S	T	U	V	W	X	Y	Z
1											
2											
3	<b>Promotions Calculations</b>										
	Rank	PML	# Pers (After Attrition)	Next Rank	# Suitable for Promo Out	# Vacancies at Next Rank	# Promos Out	# Promos Out Corrected	Rank Code	Min Promo Order	Max Promo Order
5	Pte	0	0	Cpl	0	24	0	0	0	0	0
6	Cpl	51	27	MCpl	17	0	0	1	1	4	4
7	MCpl	17	17	Sgt	3	1	1	1	2	1	1
8	Sgt	11	10	WO	0	1	0	0	3	0	0
9	WO	7	6	MWO	0	1	0	0	4	0	0
10	MWO	3	2	CWO	0	1	0	0	5	0	0
11	CWO	1	0								
12											
13											
14											
15											
16											
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19											
20											
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22											
23											
24											
25											
26											
27											

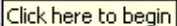
Input Background Data Intake Processing Results Year 1 Year 2 Year 3 Year 4 Year 5 Year 6 Year 7 Year 8 Year 9 Year 10

Ready NUM

-The number of promotions is calculated for each rank

-Minimum of # eligible/suitable for promotion and # vacancies at the next rank ("pull" promotion)

-Value is then corrected to backfill promotions out of the next rank (if there are enough personnel suitable for promotion)



Microsoft Excel - Model\_30yr.xls

File Edit View Insert Format Tools Data Window Help

Type a question for help

N22 =IF(AND(A22="Pte", H22=1),1, IF(K22="", "", IF(AND(K22>=L22,K22<=M22),1,"")))

	A	B	C	G	H	I	J	K	L	M	N
1	2010	Data Column	2								
2											
3	Starting Population		63								
4	Rank	YOS	Effective TIR	Eligible for Promotion?	Suitable?	Random #	Random # Modified	Rand # Order	Min Promo	Max Promo	Promoted?
5	Cpl	3	0	0	0	0.23	0.00				
6	Cpl	7	2	0	0	0.79	0.00				
7	Cpl	5	3	1	1	0.70	1.70	12	4	4	
8	Cpl	2	2	0	0	0.24	0.00				
9	Cpl	5	3							4	
10	MCpl	7	0							4	
11	Cpl	14	10							4	
12	Cpl	9	5							4	
13	Cpl	8	5							4	
14	Cpl	8	4							4	
15	Cpl	12	8							4	
16	Cpl	6	3							4	
17	Cpl	7	3							4	
18	Cpl	20	16							4	
19	Cpl	6	2								
20	MCpl	10	0								
21	Cpl	5	1								
22	Cpl	12	8	1	1	0.99	1.99	4	4	4	1
23	Cpl	7	3	1	1	0.73	1.73	11	4	4	
24	Cpl	3	1	0	0	0.00	0.00				
25	Cpl	5	2	0	0	0.56	0.00				
26	Cpl	8	5	1	1	0.75	1.75	10	4	4	
27	Cpl	4	2	0	0	0.49	0.00				

-Personnel at rank of Pte are promoted to Cpl as soon as they meet the TIR requirements.

-For other ranks, along with the three columns identified in previous slide these calculations are used to distribute the promotions randomly among the eligible/suitable candidates

Input Background Data Intake Processing Results Year 1 Year 2 Year 3 Year 4 Year 5 Year 6 Year 7 Year 8 Year 9 Year 10

Ready NUM



The screenshot displays the Microsoft Excel interface with the file named "Model\_30yr.xls". The active sheet is "Input", and the selected cell is B9. The formula bar contains the following formula:

$$=IF(A9="", "", IF(F9=1, "", IF(N9=1, VLOOKUP(A9, $P$5:$S$11, 4, FALSE), A9)))$$

	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN
1													
2													
3	<b>Original Population at End of Year</b>				<b>Intake</b>								
4	<b>Rank</b>	<b>YOS</b>	<b>Effective TIR</b>		<b>Rank</b>	<b>YOS</b>	<b>Effective TIR</b>		<b>Rank</b>	<b>PML</b>	<b>Pop at End of Year</b>	<b>Diff</b>	
5	Cpl	4	1		Cpl	0	-1		Pte				
6	Cpl	8	3		Cpl	10	-1		Cpl	51	27	24	
7	Cpl	6	4		Cpl	4	-1		MCpl	17	17	0	
8	Cpl	3	3		Cpl	3	-1		Sgt	11	11	0	
9	Cpl	6	4		Cpl	4	-1		WO	7	6	1	
10	MCpl	8	1										
11	-Rank, YOS, and TIR of the original population are updated to reflect the end of the year								-Difference between PML and original population at end of year is calculated -This value is read by the Input tab and used to determine the maximum intake at each rank to ensure that the number of personnel does not exceed the number of positions				
12													
13													
14													
15													
16													
17	Cpl	8	4										
18	Cpl	21	17										
19	Cpl	7	3										
20	MCpl	11	1										
21	Cpl	6	2										
22	MCpl	13	0										
23	Cpl	8	4										
24	Cpl	4	2										

The bottom status bar indicates the current selection is "Year 1" under the "Results" sheet.



Microsoft Excel - Model\_30yr.xls

File Edit View Insert Format Tools Data Window Help

Type a question for help

AB9 =IF(A9="", "", IF(F9=1, "", IF(N9=1, VLOOKUP(A9, \$P\$5:\$S\$11, 4, FALSE), A9)))

	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN
1													
2													
3	Original Population at End of Year				Intake								
4	Rank	YOS	Effective TIR		Rank	YOS	Effective TIR		Rank	PML	Pop at End of Year	Diff	
5	Cpl	4	1		Cpl	0	-1		Pte				
6	Cpl	8	3		Cpl	10	-1		Cpl	51	27	24	
7	Cpl	6	4		Cpl	4	-1		MCpl	17	17	0	
8	Cpl	3	3						Sgt	11	11	0	
9	Cpl	6	4						WO	7	6	1	
10	MCpl	8	1						MWO	3	2	1	
11	Cpl	15	11						CWO	1	0	1	
12	Cpl	10	6										
13	Cpl	9	6										
14	Cpl	9	5										
15	Cpl	13	9										
16	Cpl	7	4										
17	Cpl	8	4										
18	Cpl												
19	Cpl												
20	MCpl												
21	Cpl												
22	MCpl												
23	Cpl	8	4										
24	Cpl	4	2										

-Using macros, intake for the year is pasted here from the Intake Processing tab

Adding the intake for the year is done after attrition and promotion of the initial population. This implies that personnel who enter during a year cannot be released or promoted in the same year.

Input Background Data Intake Processing Results Year 1 Year 2 Year 3 Year 4 Year 5 Year 6 Year 7 Year 8 Year 9 Year 10

Ready NUM

Microsoft Excel - Model_30yr.xls												
File Edit View Insert Format Tools Data Window Help												
Type a question for help												
A175												
	A	B	C	D	E	F	G	H	I	J	K	L
1	2011	Data Column	3									
2												
3	Starting Population		68									
4	Rank	YOS	Effective TIR	P(Attrition)	Random #	Attrition?	Eligible for Promotion?	Suitable?	Random #	Random # Modified	Rand # Order	Min Promo
5	CPL	4	1	3%	0.08	0	0	0	0.39	0.00		
6	CPL	8	3	2%	0.28	0	1	1	0.20	1.20	27	10
7	CPL	6	4					1	0.94	1.94	11	10
8	CPL	3	3					1	0.52	1.52	20	10
9	CPL	6	4					1	0.93	1.93	12	10
10	MCPL	8	1					0	0.32	0.00		
11	CPL	15	11					1	0.15	1.15	29	10
12	CPL	10	6					1	0.07	1.07	30	10
13	CPL	9	6					1	0.06	1.06	31	10
14	CPL	9	5					1	0.79	1.79	14	10
15	CPL	13	9					1	0.22	1.22	26	10
65	WVO	20	2					0	0.59	0.00		
66	MWVO	28	3	8%	0.50	0	0	0	0.19	0.00		
67	MWVO	24	3	8%	0.82	0	0	0	0.56	0.00		
68	Cpl	0	-1	13%	0.63	0	0	0	0.53	0.00		
69	Cpl	10	-1	2%	0.15	0	0	0	0.61	0.00		
70	Cpl	4	-1	3%	0.20	0	0	0	0.03	0.00		
71	Cpl	3	-1	6%	0.83	0	0	0	0.02	0.00		
72	Cpl	4	-1	3%	0.86	0	0	0	0.48	0.00		
73					0.55				0.29			
74					0.83				0.98			
75					0.19				0.90			
Intake Processing Results Year 1 Year 2 Year 3 Year 4 Year 5 Year 6 Year 7 Year 8 Year 9 Year 10 Year 11 Year 12 Year 1												
Ready												
NUM												

-Using macros, End Population from Year 1 and Year 1 Intake are pasted into Starting Population for Year 2

-The simulation proceeds for the specified number of years

Microsoft Excel - Model\_30yr.xls

File Edit View Insert Format Tools Data Window Help

Type a question for help

A38 fx

	A	B	C	D	E	F	G	H	I	J	K	L
1	<b>Forecast TES Population</b>											
2	<b>Rank</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>
3	Ptel/Cpl	0	0	0	0	0	0	0	0	0	0	0
4	MCpl	17	17	17	17	17	28	31	29	31	32	27
5	Sgt	11	11	11	11	11	14	14	14	14	14	14
6	WO	6	5	7	7	7	9	8	9	9	9	14
7	MWO	2	2	2	3	3	4	4	6	6	4	6
8	CWO	0	0	1	1	1	1	1	1	1	1	1
9	<b>Total</b>	36	35	38	39	39	56	58	59	61	60	62
10												
11	<b>% PML</b>											
12	<b>Rank</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>
13	Ptel/Cpl	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
14	MCpl	100%	100%	100%	100%	100%	82%	91%	85%	91%	94%	79%
15	Sgt	100%	100%	100%						100%	100%	100%
16	WO	86%	71%	100%						60%	60%	93%
17	MWO	67%	67%	67%						100%	67%	100%
18	CWO	0%	0%	100%						100%	100%	100%
19	<b>Total</b>	40%	39%	42%						50%	50%	51%
20												
21	<b>TES Rank to Rank Ratio</b>											
22	<b>Rank</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>						<b>2018</b>	<b>2019</b>	<b>2020</b>
23	Ptel/Cpl : MCpl	0.0	0.0	0.0						0.0	0.0	0.0
24	MCpl : Sgt	1.6	1.6	1.6						2.2	2.3	1.9
25	Sgt : WO	1.8	2.2	1.6						1.6	1.6	1.0
26	WO : MWO	3.0	2.5	3.5	2.3	2.3	2.3	2.0	1.5	1.5	2.3	2.3
27	MWO : CWO	0.0	0.0	2.0	3.0	3.0	4.0	4.0	6.0	6.0	4.0	6.0
28												
29	<b>TES Attrition Volume</b>											

-Results for all years for a single iteration are summarized here

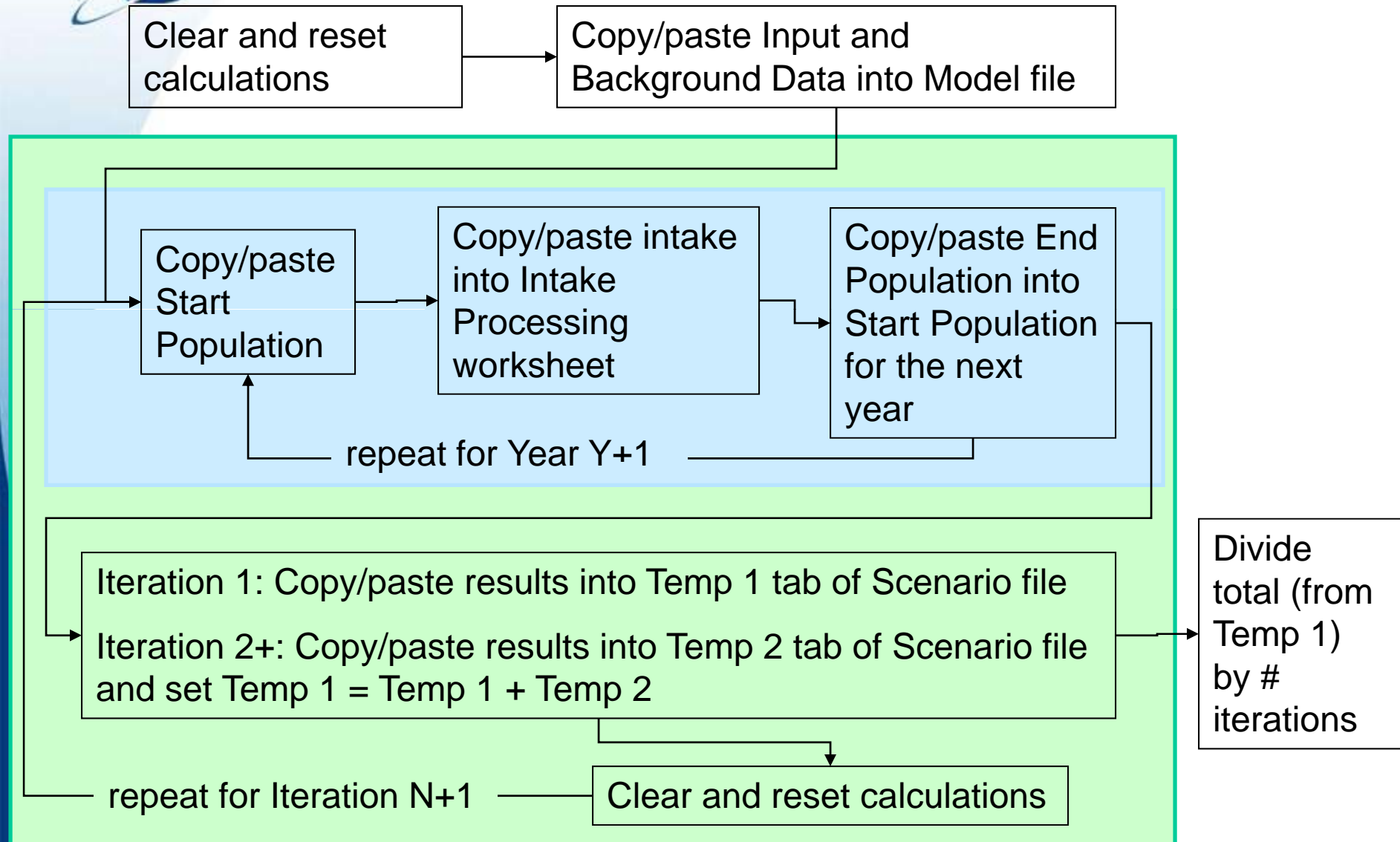
-As noted earlier, macros are used to average the results over all iterations in the Scenario file

Intake Processing Results Year 1 Year 2 Year 3 Year 4 Year 5 Year 6 Year 7 Year 8 Year 9 Year 10 Year 11 Year 12 Year 1

Ready NUM



## Summary of Key Processes (Macros)





## Part 2: Example



## Aim

- To determine the anticipated growth of a Canadian Forces occupation from 2010 to 2029 over three growth phases:
  - PML = 90
  - PML = 121
  - PML = 254

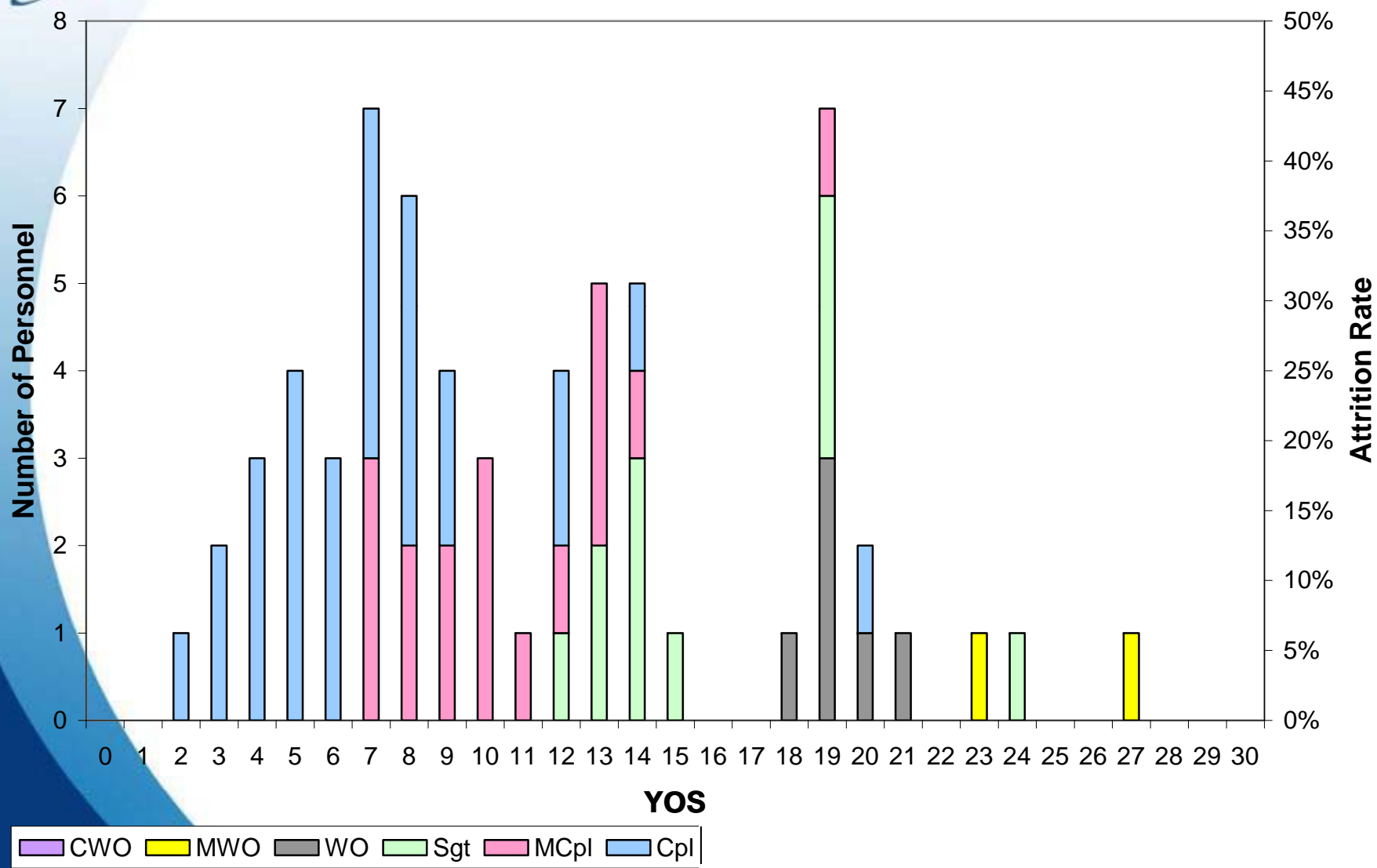


## Simplifying Assumptions

- All entrants are counted toward TES immediately
- DE personnel are assigned YOS of 1 upon entry to account for one year prior to OFP (e.g. selection, training)
- YOS distribution of VOT entrants follows CF average distribution for Cpl, MCpl, Sgt
- VOT entrants require extra year before being eligible for promotion to MCpl



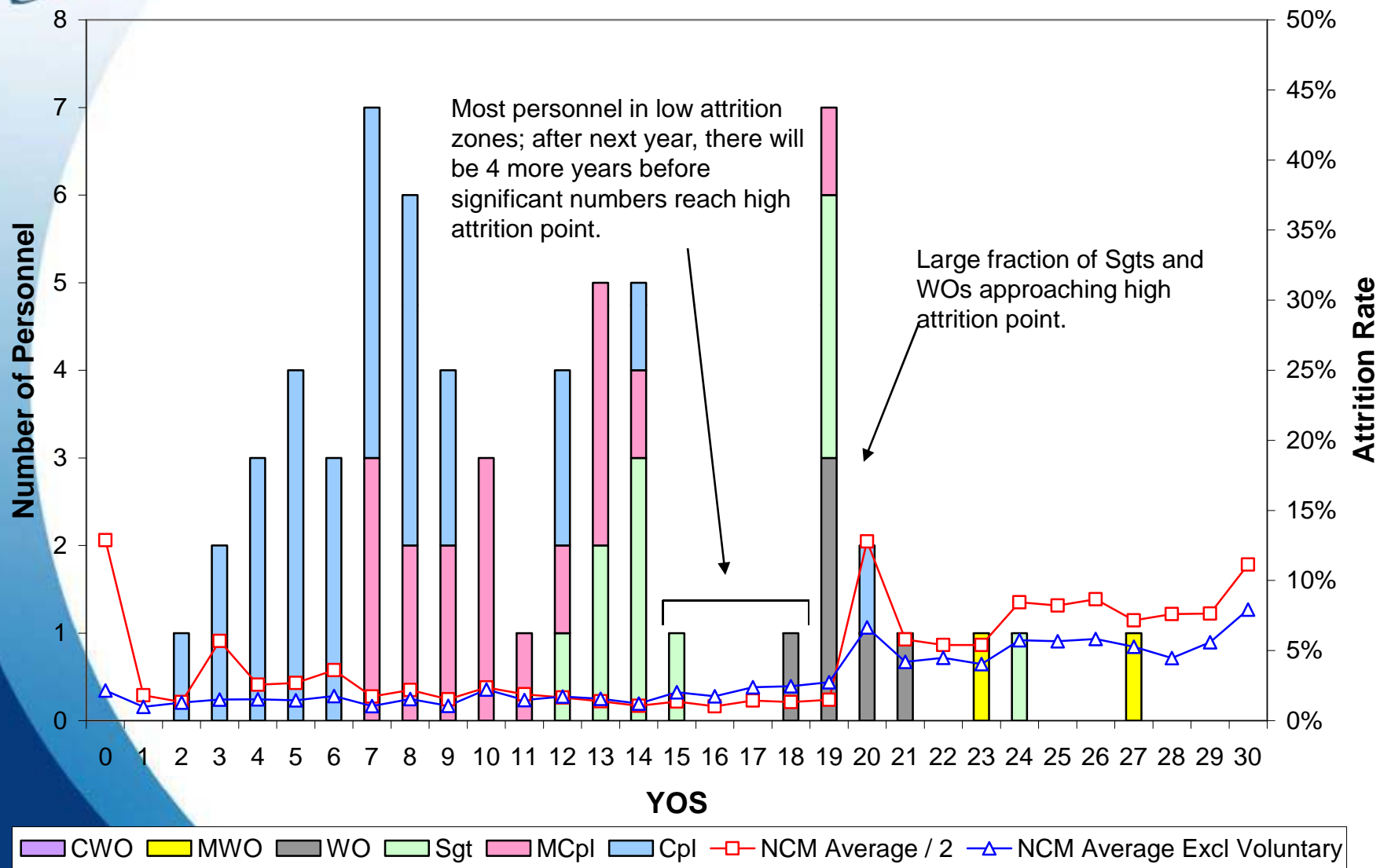
# Initial Population Profile







# Initial Population Profile





## Scenario Parameters - General

- 20-year simulation (2010-2029)
- 20 iterations
- Three sets of TIR requirements for promotion

TIR Requirements for Promotion	High		Medium		Low	
Entry Plan	DE	VOT	DE	VOT	DE	VOT
Pte(T)	3	N/A	3	N/A	3	N/A
Cpl	3	4	2	3	2	3
MCpl	4	4	3	3	2	2
Sgt	6	6	4	4	3	3
WO	6	6	4	4	3	3
MWO	6	6	4	4	2	2

- Two attrition by YOS profiles
  - **Attrition Profile 1: ½ NCM Average**
  - Attrition Profile 2: NCM Average Excluding Voluntary



## Scenario Parameters - PML

- PML is increased to the next level only when the previous level is reached
  - PML is considered reached if:
    - 98% of positions at each rank from Pte(T)/Cpl to Sgt are filled
    - 85% of WO positions are filled, and
    - 90% of MWO/CWO positions are filled

Rank	Initial TES	PML=90	PML = 121	PML = 254
Pte(T)/Cpl	27	51	51	127
MCpl	17	17	34	61
Sgt	11	11	14	37
WO	6	7	15	20
MWO	2	3	6	7
CWO	0	1	1	2
Total	63	90	121	254

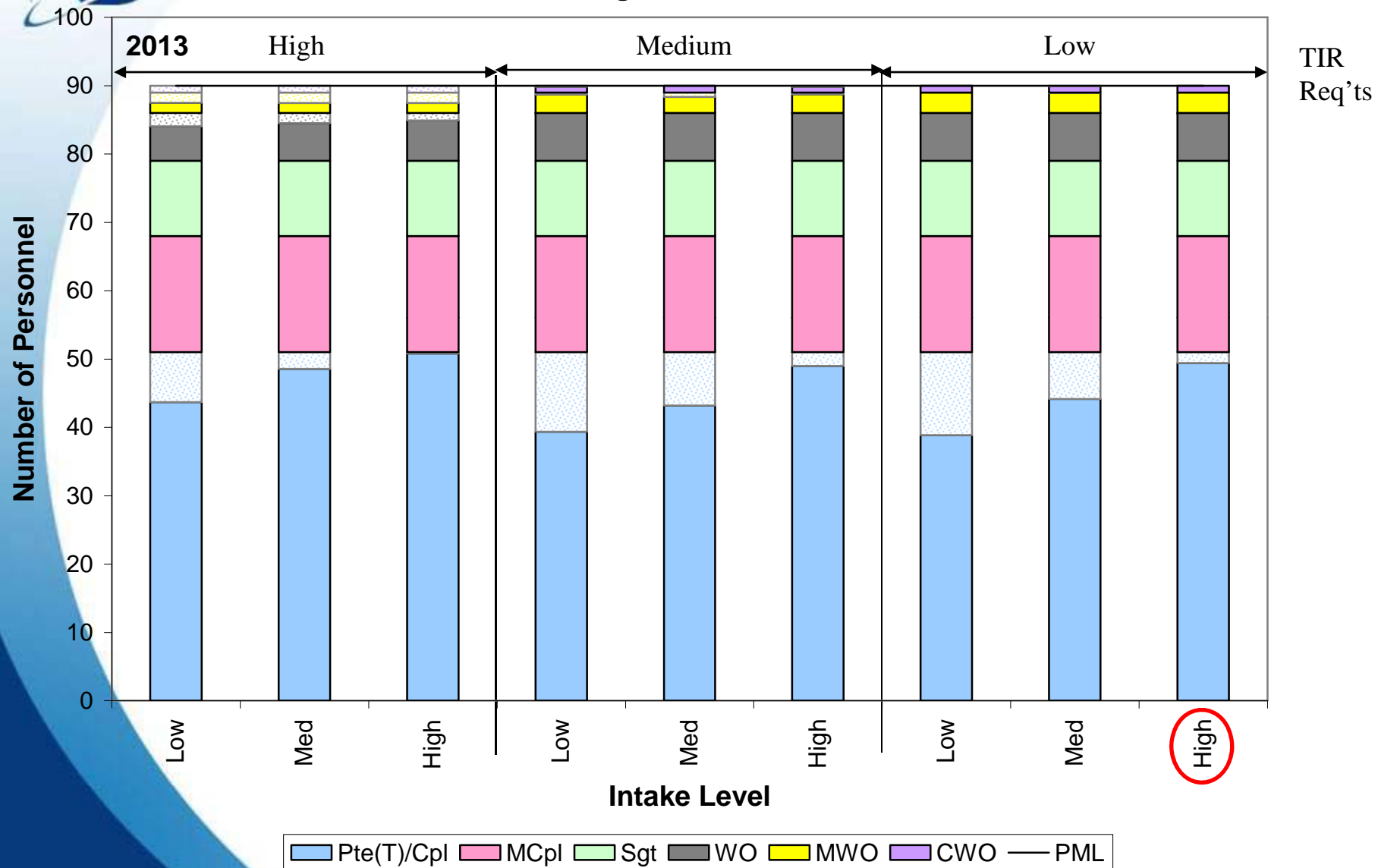


## Scenario Parameters – Intake (Pte(T)/Cpl)

Intake	2010	2011	2012	2013+
Low	5 VOT	5 VOT	4 VOT	4 VOT, 5 DE
Medium	5 VOT	5 VOT	4 VOT	4 VOT, 10 DE
High	5 VOT	5 VOT	4 VOT	4 VOT, 15 DE

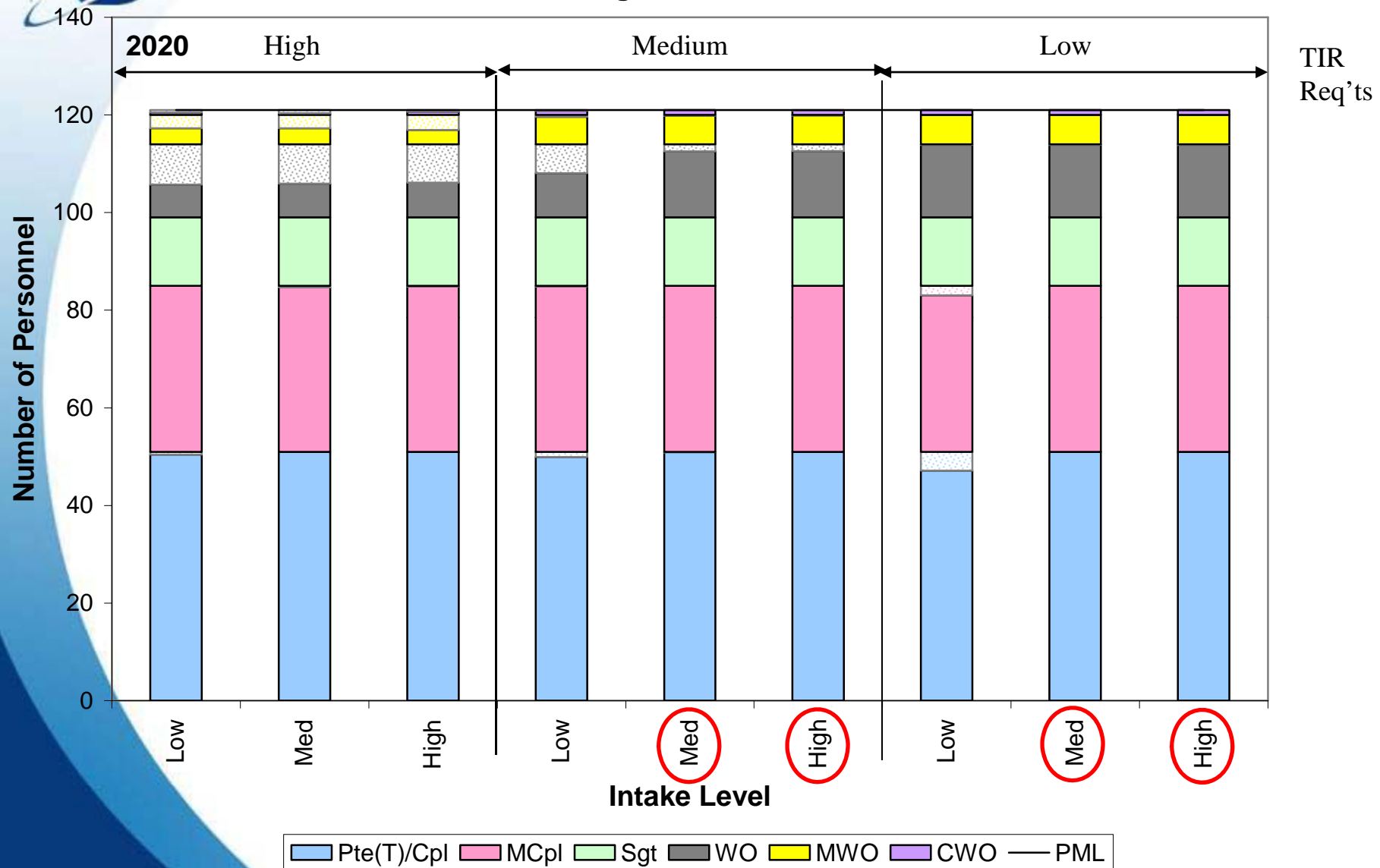


## Average TES vs PML



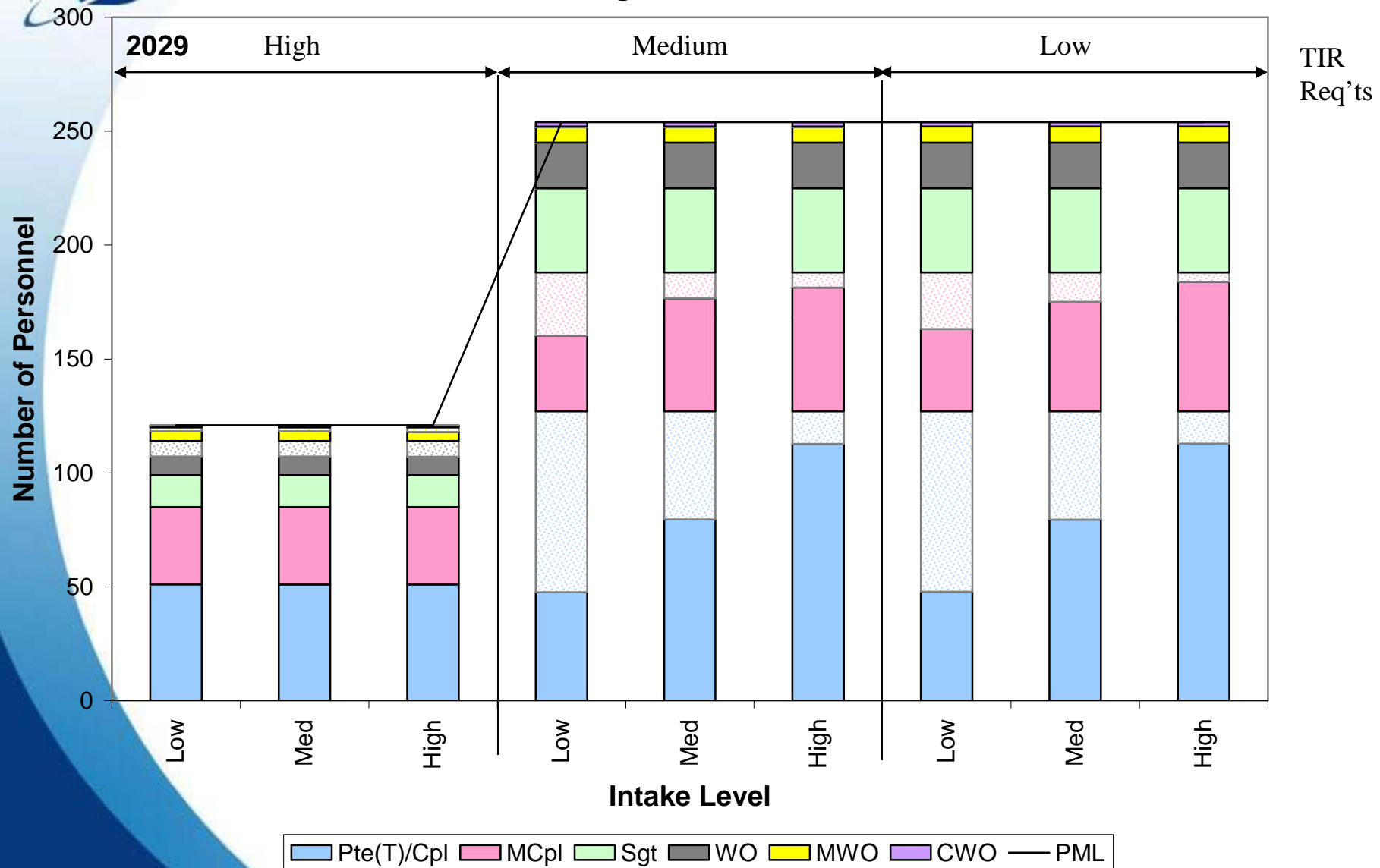


## Average TES vs PML



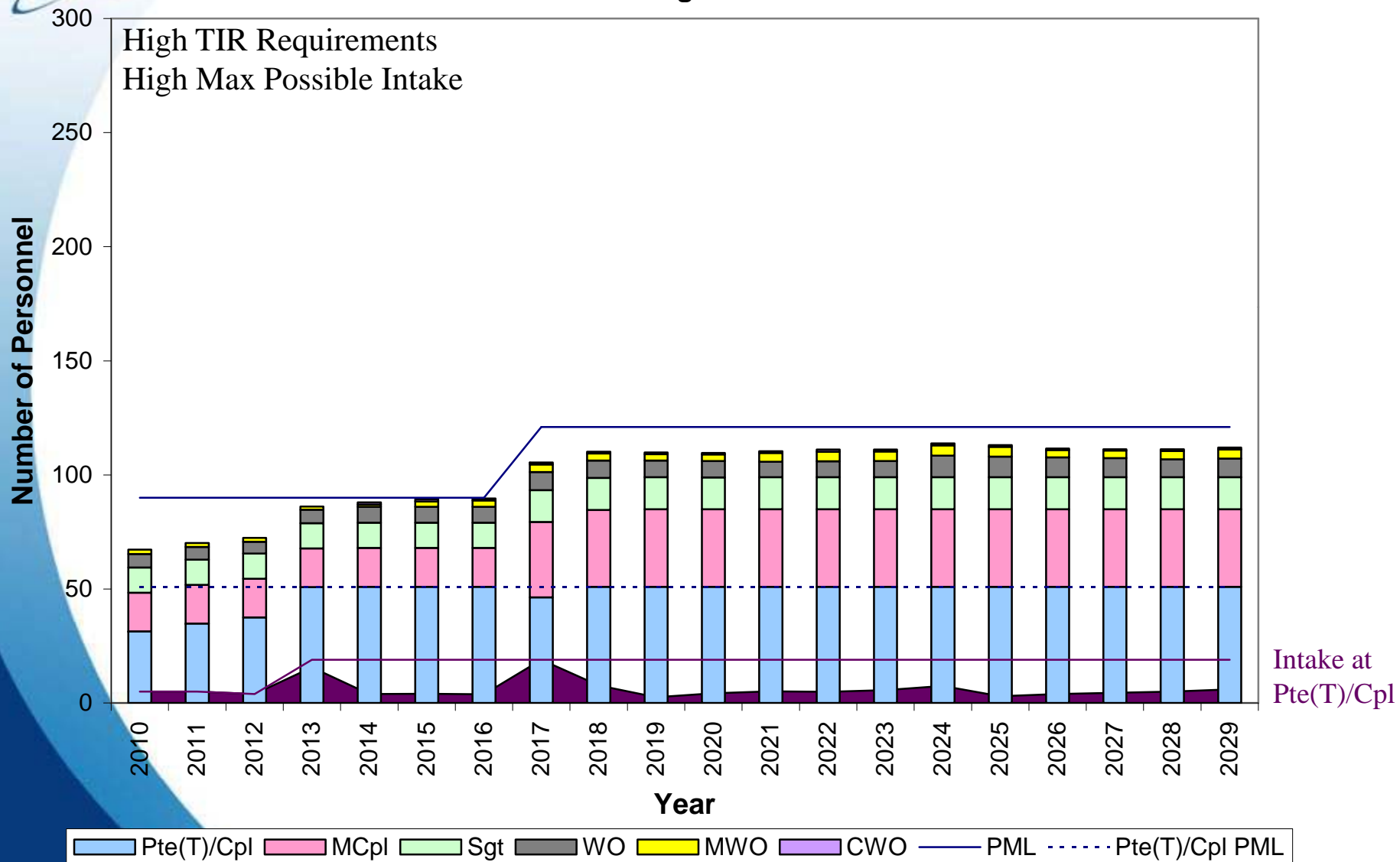


## Average TES vs PML





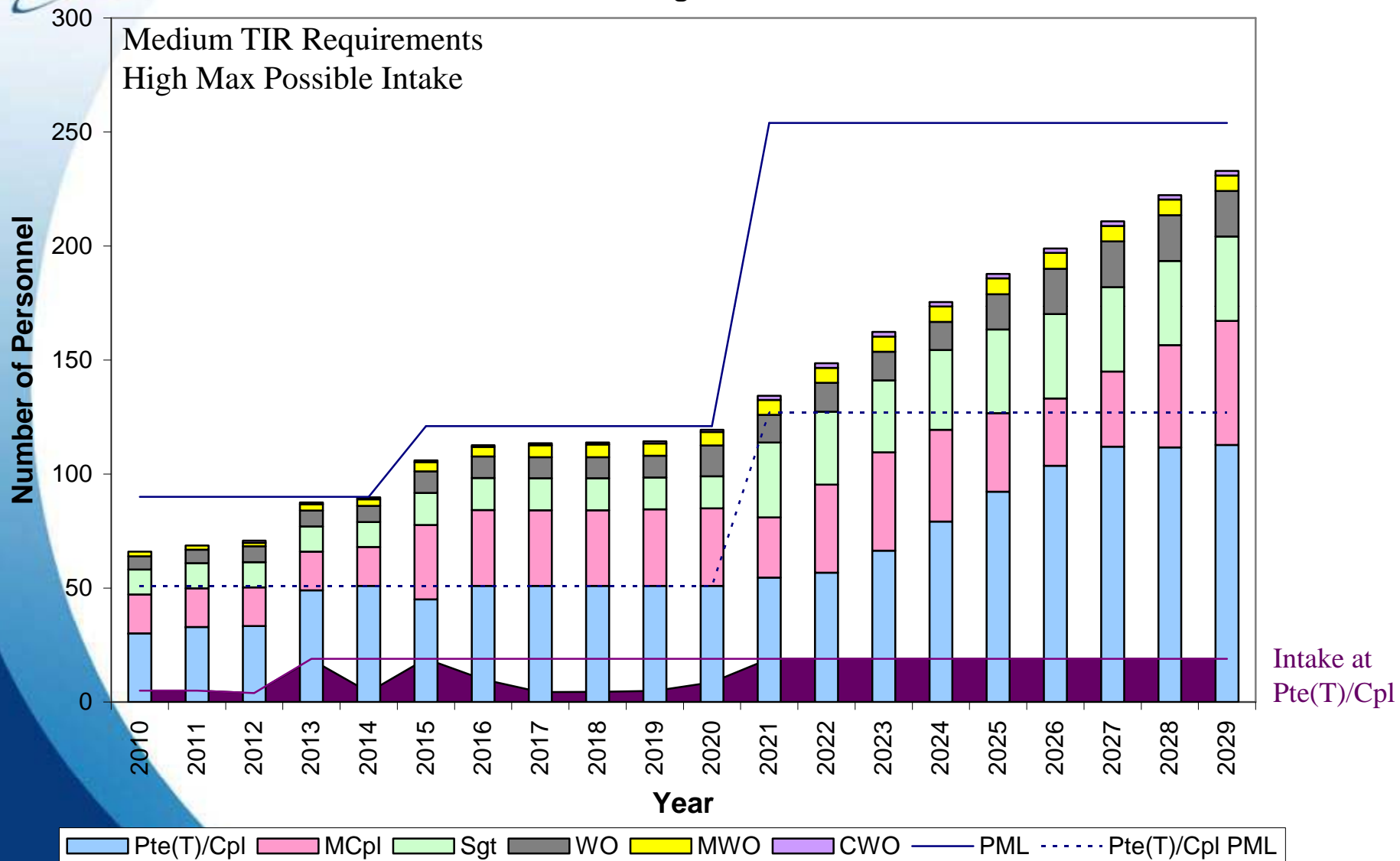
## Average TES





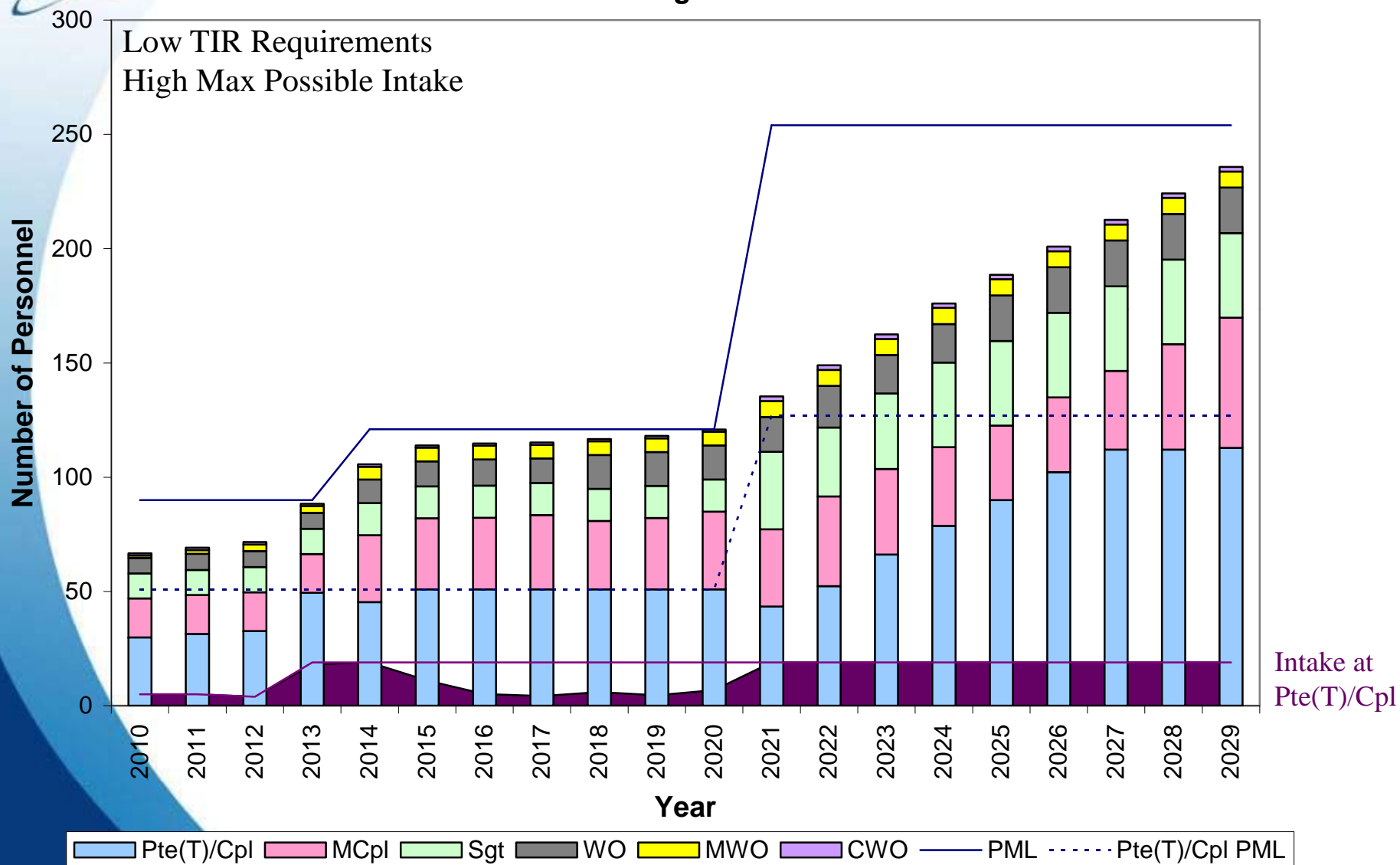


## Average TES





## Average TES





## Observations

- TIR requirements for promotion influence ranks at which shortages occur. In general:
  - High: Shortages occur at senior ranks because it takes many years for personnel to reach these ranks; therefore the probability of attrition before reaching WO/MWO/CWO is relatively high
  - Low: Shortages occur at junior ranks because personnel are promoted quickly; intake may not be high enough to fill the vacancies left by promoted personnel
- Medium TIR requirements achieve a balance between desired experience level at each rank and the need to grow the occupation



## Caveats

- Due to small size of occupation, small variations in expected values of parameters (attrition, intake, etc) can have strong impact on outcome
- Attrition rate profiles used in these scenarios were low (in comparison to NCM historical average), as recommended by SMEs
  - Low attrition rates can be expected in the near term, but long-term attrition rates are difficult to forecast
  - Any increases in future attrition will have significant impact on growth of occupation



## Conclusions and Recommendations

- High TIR requirements for promotion will impair growth
  - Strongly recommend reducing TIR requirements (although it may be possible to increase them after growth is complete)
- WO positions will be difficult to fill during PML=121 phase
  - Could be addressed through adjustments to PML or by reducing TIR promotion requirements



## Conclusions and Recommendations

- If all positions can be filled more quickly during the PML-121 phase, expansion to PML-254 can begin earlier
  - This will allow expansion at the Pte(T)/Cpl rank to be completed sooner
- Due to significant impact that changes in planning factors (e.g. attrition rate) can have on outcome, it is recommended that the modelling be redone periodically throughout the transition

DEFENCE



DÉFENSE